

METHOD AND APPARTUS FOR ENTERING DATA WITH A FOUR WAY
INPUT DEVICE

5 The present invention to input devices and methods for
entering data in a an electronic terminal, preferably a
mobile communication terminal. The invention relates in
particular to a method of using joystick movements to
enter data and to a mobile communication terminal
incorporating such a method.

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BACKGROUND ART

Current mobile communication terminals generally comprise
at least a 12-key alpha numeric keypad, for composing
15 telephone numbers and text messages, and a number of
additional function keys, for initiating communications
to a desired telephone number, turning the terminal on
and off, navigating and selecting in the menu structure,
etc.

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Current mobile communication terminals provide a host of
features but as electronic functionality is increasingly
miniaturized, the size of a usable touch-typing keypad
becomes much larger than the package needed for many
25 modern devices. Thus, there is an increasing need for a
widely acceptable method for entering data that can be
easily incorporated into small handheld devices.

One proposed solution to this problem has been to use a
30 joystick for entering characters. EP 1 168 147 purports
to such a method of entering characters and commands
using a eight-way joystick. In accordance with EP 1 168
147, a first plurality of selectable choices
corresponding to some of the eight ways is presented to a

user on a display. At least one of the choices represents a sub-set of the set of characters. The user then selects one of said first plurality of selectable choices by moving the joystick from the center position into one of the eight ways. Next, a second plurality of selectable choices corresponding to the eight ways is presented to the user, at least one of which represents a character of the selected choice; and the a character from the second plurality of selectable choices is selected with a joystick movement from the center position into one of the eight ways.

Another proposed system disclosed in US2001/0048425 uses a twelve way joystick or 12-directional pad for alphanumeric and direction input. The twelve ways are allocated respective numerical values and letter groups. The sensors of the joystick are of the cascade type and divide the joystick movement range into two zones. The ambiguous entry letter groups is disambiguated by repetitive actuation of the joystick in the direction to which the letter group is allocated in and out to the outer zone, whereby one move in and out of the outer zone represents the entry of the first letter in the group, two movements in and out of the outer zone represents the entry of the second letter in the group, etc. Alternatively it is proposed to use a predictive editor application to disambiguate the ambiguous entries.

WO 03/048884 discloses a method in which an 8-direction joystick is used as an input device for inputting characters into an electronic mobile device. The electronic mobile device receives input signals when a user navigates the 8-direction joystick through a predefined input stroke sequence. The input signals are

matched to a plurality of reference input stroke sequences comprising 3 to 6 strokes each. A character entry is derived from the recorded stroke sequence.

5 US 5,982,303 discloses a method in which an array of eight keys is used to enter data into an electronic mobile device. Ordered pairs of keystrokes are transformed into a full complement of alpha-numeric characters. The method employs an alphabet in which each
10 character is represented by a two-stroke pictographic picture. The user presses the key corresponding to the beginning and ending points of the pictograph of the desired character.

15 Finally, the availability of powerful computers in small packages has given rise to systems that bypass the use of keys or joysticks entirely, including, for example, voice recognition software which is responsive to spoken words, and handwriting recognition software which is responsive
20 to a special stylus and touch screen.

DISCLOSURE OF THE INVENTION

Each of the above referenced systems, however, suffers
25 for deficiencies which limit their usefulness. Presenting selections and sub-selections - such as disclosed by EP 1 168 147 - leads to a multi step process in which the user needs to wait for the next display with sub-selections to appear and requires pivoting the joystick at least twice
30 out of the center position and back for each entry. This method is therefore relatively slow and cumbersome.

A twelve-way joystick, such as the US2001/0048425 patent application, requires a relatively complicated joystick

construction with twelve sensors. Further, division into 12 ways results in a relatively small angle of only 30° between the individual ways. The user needs therefore to pivot the toggle stick very accurately in the correct
5 direction in order to avoid inadvertent character entries.

The joystick movement sequence arrangement of the WO 03/048884 patent application uses relatively long
10 sequences to enter a character, e.g. six consecutive movements of the toggle stick are required to enter a letter M or a letter S. The number of joystick movements to write the word "mast" is $6+4+6+4=20$. Furthermore, the activation sequences for each letter of the alphabet have
15 to learned or memorized by the user, a factor that will, given the average interest of users to learn once more how to write, probably receive have a low user acceptance. The method of the WO 03/048884 patent application does not present any solution to entering
20 digits.

About 80 pictograms are used in the two-stroke key entry method disclosed in US 5,982,303. A user has to learn, memorize or look up these pictograms before use, which
25 presents a significant hurdle to user-acceptance of such an input system.

Finally, while voice recognition systems do not require visual monitoring, they require speaking out loud, which
30 is distracting and unsuitable for situations such as business meetings. Moreover, voice or handwriting recognition systems are less reliable than keystroke systems because they require the computer to interpret

voice and handwriting patterns which may vary significantly from one user to the next.

On this background, it is an object of the present
5 invention to provide a method of entering data in an electronic terminal with a standard four way input device using a minimum number of required strokes and allowing a new user to employ the method immediately.

10 This object is achieved in accordance with claim 1 by providing a method for entering data in an electronic terminal having a four-way input device with a center position and a sensor associated with each of the four ways, the method comprising the steps of: allocating a
15 data value to each of the four possible input device movement sequences that comprise a movement of the input device from the center position in one of the four ways followed by a return of the input device to the center position, allocating a data value to each of the eight
20 possible input device movement sequences that comprise a movement of the input device from the center position in one of the four ways followed by a movement of the input device in another of the four ways without passing through the center position, detecting the input device
25 movement sequences with the sensors associated with the four ways and entering the data allocated to an input device movement sequence upon detection by the sensors of the input device movement sequence concerned.

30 The method according to the present invention provides a number of advantages. It allows the same entries as a conventional key pad with twelve keys with a standard four way digital joystick or four directional pad. The standard twelve key keypad of e.g. mobile phones can thus

be replaced by a single joystick, allowing further miniaturization of the terminals.

Moreover, a sequence of maximum two joystick movements is
5 needed to enter a data value, allowing fast entry of digits and letters.

The twelve different sequences possible can easily be printed as a hard label around the joystick, allowing a
10 new user to recognize immediately how the data is to be entered. By arranging the allocation of the digits in accordance with the layout of an analogue clock the ease of use for a new user is further increased and general user acceptance improved.

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Letter groups are preferably assigned to the movement sequences in a manner analogue to the assignment of letter groups to the keys of a standard 12 key, mobile phone keypad.

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Ambiguous entry of letter groups is preferably disambiguated where possible by the use of a predictive editor program. In those situations where a predictive editor program cannot be used, e.g. when entering family
25 names in the phonebook, subsequent activations of the joggle stick in the center position are used to disambiguate the data input.

The terminal used in the method is preferably capable of
30 assuming a plurality of states, such as a numeric state and text state. In the numeric state the entry of digits are associated with the movement sequences. In the text state letter groups are associated with the movement sequences.

Digits can be entered in the text state by holding the dome switch at the end position of the last movement for a period of time that exceeds a threshold.

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It is another object of the present invention to provide mobile communication terminal with a user interface comprising a standard four way input device that requires few strokes to enter data and can be used by a new user immediately.

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This object is obtained in accordance with claim 16, by providing a mobile communication terminal comprising: a display, a four-way input device with a middle position and a sensor associated with each of the four ways, a processor unit monitoring the activation of the sensors and controlling the information shown on the display, a data value being assigned to each of the four activation sequences that comprise the activation of one of the four sensors followed by a return to the middle position in which none of the four sensors is active, and a data value or being assigned to each of the eight activation sequences that comprise the activation of one of the four sensors and whilst the sensor concerned is active followed by the activation of one of the other sensors, the processor unit upon detection of an activation sequence having a data value allocated therewith accepting the data value concerned as entered.

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It is yet another object of the present invention to provide mobile communication terminal with a user interface comprising a display and a minimum number of keys in combination with a standard four way input device.

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This object is obtained in accordance with claim 22, by providing a mobile communication terminal comprising: a display, a four four-way input device with a middle position and being movable in at least four preferably orthogonally arranged ways, a center sensor being associated with the middle position and an outer sensor being associated with each of the four ways, a processor unit monitoring the activation of the center and outer sensors and controlling the information shown on the display, data values being assigned to activation sequences that comprise one two or more activations of one of the four outer sensors, the processor unit upon detection of an activation sequence having a data value allocated therewith accepting the data value concerned as entered, the function of the center sensor being controlled and displayed by the processor unit in a dedicated area of the display.

The terminal according to the present invention provides a number of advantages. The input device can be used for navigation, function selection, text and number entry as well as control of applications such as gaming. This is possible since the center sensor is used as a a so-called multifunctional soft-key. The selectable functions can comprise call and message handling functions as well as menu item activation. The input device can be used for navigation and thus call handling, message handling, menu control and navigation, text and number handling, gaming and other applications can be handled by a single input device. With the present invention the a full feature user interface thus be provided by a single joystick in combination with a display. Thus, rendering the standard twelve key keypad obsolete and allowing further

miniaturization of mobile communication terminals without substantial drawbacks in the quality of the user interface.

- 5 The terminal preferably comprises a menu structure with a hierarchical tree-structure or a lateral menu structure. The processor may allocate navigational commands to the data values when the menu is entered in order to navigate through lists of menu items and associated the activation
10 of the center sensor with the selection of a marked menu item.

The processor may associate the activation of a first predetermined pair of outer sensors with a clear or
15 backspace function in the mode for numerical entry and the a mode for text entry.

The processor may associate the activation of a second predetermined pair of outer sensors with a change in the
20 characters or commands allocated to the data values. Thus, the function of the input device could shift from e.g. text entry to cursor control/navigation through the text.

- 25 It is a further object of the present invention to provide a method for entering text in a mobile communication terminal with a user interface comprising a display and a minimum number of keys in combination with a standard four way input device.

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This object is achieved in accordance with claim 27 by providing a method of entering characters in a terminal with a four-way or five-way input device, a display and a processor controlling the display and monitoring the

activation of the input device, comprising the steps of defining a plurality of sequences of activation of the input device that involve at least two activations, assigning groups of letters to the defined sequences of activation, monitoring the activation of the input device, entering a group of letters when the associated activation sequence is detected, and sending the entered group of letters to an predictive editor application capable of outputting a word based on a string of received letter groups.

It is also an object of the present invention to provide a mobile communication terminal with a user interface comprising a display and a minimum number of keys in combination with a standard four way input device.

This object is achieved in accordance with claim 28 by providing a mobile communication terminal comprising a display, a four four-way input device with a middle position and being movable in at least four preferably orthogonally arranged ways, a center sensor being associated with the middle position and an outer sensor being associated with each of the four ways, a processor unit monitoring the activation of the center and outer sensors and controlling the information shown on the display, said terminal being capable of assuming a plurality of modes, the functions associated with activations of the outer sensors, or sequences of activation of the outer sensor of said input device being controlled by the processor in dependence of the mode of the terminal and comprising navigation, the entry of digits and the entry of text, the function of the center sensor being controlled and displayed by the processor

unit in dependence of the mode of the terminal and being shown in a dedicated area of the display.

It is a further object of the present invention to provide a method for entering data in mobile communication terminal with a user interface using only four keys.

This object is achieved in accordance with claim 29 by a method for entering data in an electronic terminal having an array comprising four keys and a sensor associated with each of the four keys, the method comprising the steps of: allocating a data value to each of the four possible key stroke sequences that comprise an activation of a sensor followed by the deactivation of the sensor concerned whilst no other sensor becomes active; allocating a data value to each of the eight possible key stroke sequences that comprise an activation of a first sensor followed by an activation of another sensor whilst the first sensor is active; detecting the key stroke sequences with the sensors associated with the four keys; and entering the data allocated to an input device movement sequence upon detection by the sensors of the key stroke sequence concerned.

Finally, it is an object of the present invention to provide a method for entering data in mobile communication terminal with a user interface using only five keys.

This object is achieved in accordance with claim 30 by a method for entering data in an electronic terminal having an array comprising five keys and a sensor associated with each of the five keys, one of the five keys being an enter key, the other four keys being input keys, the method comprising the steps of: allocating a data value

to each of the four possible key stroke sequences that
comprise an activation of a sensor of an input key
followed by the activation of the sensor of the enter
key; allocating a data value to each of the eight
5 possible key stroke sequences that comprise an activation
of a first sensor of an input key followed by an
activation of another sensor of an input key and
preferably followed by the activation of the sensor of
the enter key; detecting the key stroke sequences with
10 the sensors associated with the five keys; and entering
the data allocated to an input device movement sequence
upon detection by the sensors of the key stroke sequence
concerned.

15 Further objects, features, advantages and properties of
the methods and terminals according to the invention will
become apparent from the detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

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In the following detailed portion of the present
description, the invention will be explained in more
detail with reference to the exemplary embodiments shown
in the drawings, in which

25 Fig. 1 is a frontal view of a first preferred embodiment
of a terminal according to the invention,

Fig. 2 is a block diagram illustrating the general
architecture of the terminal of Fig. 1,

Fig. 3 is a top view on a first preferred embodiment of
30 an input device according to the invention,

Fig 4, is a cross-sectional view along line IV-IV of Fig.
3,

Figs. 5 and 6 illustrate a variation of the input device
illustrated in Figs. 3 and 4,

Fig. 7 illustrates a second preferred embodiment of the input device according to the invention,
Fig. 8 is a flow chart illustrating the operation of the input device according to the invention,
5 Fig. 9 is a frontal view of a second preferred embodiment of a terminal according to the invention,
Fig 10. is a flow chart illustrating the operation of the input in accordance with the second preferred embodiment of a terminal according to the invention,
10 Figs. 11.1 to 11.3 represent a sequence of displays illustrating dialing and initiating a call,
Fig. 11.4 is a display illustrating the detection of an incoming call,
Figs. 12.1 and 12.2 are displays illustrating the
15 operation of the menu structure,
Figs. 12.3 to 12.5 illustrate the initiation of a call from the last dialer numbers list,
Figs. 13.1 to 13.6 illustrate the entry of text using a predictive editor application,
20 Figs. 14.1 to 14.3 illustrate the correction of a mistyped word,
Fig. 15 illustrates a flow diagram for the editor application,
Fig. 16 discloses a third preferred embodiment of the
25 invention, and
Fig. 17 discloses a variation of the third preferred embodiment.

DETAILED DESCRIPTION

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In the following detailed description, a mobile communication terminal according to the invention in the form of a hand portable phone, preferably a

cellular/mobile phone, will be described by the preferred embodiments.

Fig. 1 shows a preferred embodiment of a mobile phone 1 according to the invention. The mobile phone 1, comprises a user interface having a joystick 2, a display 3, an on/off button 4 (not shown, present though in the top of the phone) a speaker 5, and a microphone 6 (only the opening present in the bottom of the phone is visible). The mobile phone 1 according to the preferred embodiment is adapted for communication via a cellular network, such as the GSM 900/1800 MHz network, but could just as well be adapted for use with a Code Division Multiple Access (CDMA) or G3 network.

According to a preferred embodiment, the joystick 2 has four sensors associated with the four orthogonal ways of the joystick, and a center sensor that can be activated by pressing joystick in the center position. The present functionality 22 of the center sensor is shown in a separate field 21 (soft-label) in the display 3 just above the joystick 2. The center sensor thus acts as a multifunction key and its present function depends on the state of the mobile phone 1. The center sensor can give access to the menu, the phonebook and can activate actions related to call handling and message handling. An exchangeable battery pack (not shown) is received in a covered recess on the rear side of the mobile phone 1.

Fig. 2 schematically shows the most important components of a preferred embodiment of the mobile phone 1, i.e. the components essential to the understanding of the invention. The processor 18 controls the communication

with the network via the transmitter/receiver circuit 19 and an internal antenna 15.

The microphone 6 transforms the user's speech into
 5 analogue signals, the analogue signals formed thereby are
 A/D converted in an A/D converter (not shown) before the
 speech is encoded in a digital signal processing unit 14
 (DSP). The encoded speech signal is transferred to the
 processor 18, which i.e. supports the GSM terminal
 10 software. The processor 18 also forms the interface to
 the peripheral units of the apparatus, including a RAM
 memory 17a and a Flash ROM memory 17b, a SIM card 16, the
 display 3 and the joystick 2 (as well as data, power
 supply, etc.). The DSP 14 speech-decodes the signal,
 15 which is transferred from the processor 18 to the speaker
 5 via a D/A converter (not shown).

Figs. 3 and 4 illustrate the a preferred embodiment of
 the joystick 1 in a top view and a cross-sectional view.
 20 The joystick 2 comprises a toggle stick 43 that is
 connected a quadratic plate 44. The plat 44 is pivotally
 connected to a base plate 45 via a ball-joint 46. The
 toggle stick can thus be pivoted out of shown the centre
 position in any direction in the plane of the base plate.
 25 Four dome switches S1..S4 form the outer sensors of the
 joystick 2. The dome switches S1..S4 are arranged on the
 base plate under the corners do the dome plate 44, i.e.
 when the toggle stick 43 is pivoted in the direction of
 arrow 61 switch S1 is activated, when the toggle stick is
 30 pivoted in the direction of arrow 62 switch S2 is
 activated etc.

As illustrated in Fig. 4, the joystick 2 comprises a
 toggle stick 43 mounted in the center of the quadratic

plate 44. A centrally placed pivot pin 46 with a spherical head protrudes from the bottom of plate 44. The spherical head of the pivot pin 46 is received in a corresponding recess in a quadratic base plate 45.

5

The base plate is provided with four dome switches S1,S2,S3,S4, one on each corner of the base plate. The dome switches S1..S4 are resilient and urge the plate 44 in a position parallel to the base plate 45. The toggle stick 43 can thus be urged to pivot out of the center position and returns automatically to the center position when no force is applied to it.

The base plate 45 is mounted on and electrically connected with a printed circuit board 33 inside the mobile phone. The toggle stick 43 protrudes from the mobile phone 1 through an opening in the front cover 29.

The toggle stick 43 is provided with a downwardly opening central longitudinal recess that is placed over a pin 47 that protrudes from the upper side of plate 44. A dome switch S5 is placed on top of the pin 47 and engages the internal end of the recess in the toggle stick. When the toggle stick 43 is pushed down in the direction of arrow 65 switch S5 is activated. The dome switch S5 is resilient and when no downward force is applied to the toggle stick the switch S5 returns automatically to its non-active position. The construction allows the center switch to be activated in any position of the toggle stick, i.e. the toggle stick does not need to be in its neutral position to activate the center switch.

As an alternative to the center switch S5, the activation of all four switches S1,S2,S3 and S4 can be used as a center switch.

- 5 When the toggle stick 43 is pivoted in the direction of arrows 61,62,63,64 switches S1,S2,S3,S4 are activated respectively.

Data is entered in the mobile phone by sequences of joystick movements. On the front cover of the phone the joystick movement sequences are depicted as hard labels around the opening through which the toggle stick 43 protrudes through the front cover 29. Depending on the state of the mobile phone numbers or text is entered. In
10 a numeric mode, digit "3" is entered by pivoting the toggle stick 43 in the direction of arrow 62. Digit "4" is entered by pivoting the toggle stick 43 in the direction of arrow 62 and then, without returning to the middle position, pivoting the toggle stick 43 in the
15 direction of arrow 63. In the text mode these joystick movement sequences correspond to the entry of one of the letter group "abc" and "ghi" respectively. The handling of the ambiguous entry of letters is described in detail further below.

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The processor monitors the joystick movements through the switches S1 to S4. Fig. 8 is a flowchart that illustrates the operation of the process of entering a data value in the phone. At step 8.1 the process is started. The
30 processor 18 monitors the state of the switches S1..S5 via interrupt request lines (IRQ), step 8.2. In step 8.3 the processor 18 monitors if one of the sensors is active. If not, the processor returns to step 8.3 again to monitor if one of the switches is active. If one of

the sensors is active, its value is saved in step 8.4. In step 8.5 the processor monitors if a second sensor is activated whilst the first sensor is still active. If yes, the value of the second sensor is saved and the process moves on to step 8.8. If no second sensor is activated whilst the first sensor is active the processor monitors in step 8.7 when the first sensor becomes inactive. The monitoring is continued until the first sensor has become inactive. Then, the process moves on to step 8.8. When the process arrives at step 8.8 the processor 18 looks up in a table which data value corresponds to the recorded switch activation sequence. Table 1 shows which data values are allocated to the different sensor activation sequences:

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First state active switches:	Second state active switches:	Data value entered
S1	-	0
S1	S1+S2	1
S2	S1+S2	2
S2	-	3
S2	S2+S3	4
S3	S2+S3	5
S3	-	6
S3	S3+S4	7
S4	S3+S4	8
S4	-	9
S4	S1+S4	10
S1	S1+S4	11

Table 1.

Depending on the state of the mobile phone (different states explained in detail below) different characters, letter groups or functions are associated with a particular data value and in a preferred embodiment the association is as shown in table 2 below:

Data value entered	Associated digit / character in numeric entry mode	Associated characters / function in text entry mode	Associated function in navigation mode
0	0	Space	Move up ↑
1	1	.,-?!'@:	-
2	2	abc	-
3	3	def	Move right →
4	4	ghi	-
5	5	jkl	-
6	6	mno	Move down ↓
7	7	pqrs	-
8	8	tuv	-
9	9	wxyz	Move left ←
10	*	Alternative	-
11	#	Shift	-

Table 2.

After entering the data value the process returns to step 8.3 to monitor the activation of the sensors.

A tone can be sounded for each sensor activation, followed by a input confirmation tone when a data value is successfully entered, or followed by a rejection tone when the data value entry failed.

Figs. 5 and 6 show a variation of the joystick construction that can also be used with the present invention. The joystick according to this embodiment is substantially identical to the joystick illustrated in Figs. 3 and 4. The switches S1,S2,S3,S4 are however not located in the corners of the base plate but instead at the middle of the side surfaces of the quadratic base plate. Thus, when the toggle stick 43 is pivoted in the direction of arrow 61 switches S1 and S4 are activated simultaneously. When pivoted in the direction of arrow 62 switches S1 and S2 are activated simultaneously and so on for the other directions. The combined switches S1 and S2 thus form sensor for detecting joystick movement in the direction of arrow 62. The input process of Fig. 8 in principle identical, in that the processor treats the different simultaneous activations as sensor activations. In order to arrive at the same data values for the same joystick movement sequences the look up table used is modified as shown in table 3 below:





First state active switches:	Second state active switches:	Data value entered
S1+S4	-	0
S1+S2	S1+S4	1
S1+S4	S1+S2	2
S1+S2	-	3
S1+S2	S2+S3	4
S2+S3	S1+S2	5
S2+S3	-	6
	S3+S4	7
S3+S4	S2+S3	8
S3+S4	-	9

S3+S4	S1+S4	10
S1+S4	S3+S4	11

Table 3.

The characters and commands associated with the entered
 5 data values can be the ones illustrated in table 2.
 above.

According to a second preferred embodiment - illustrated
 in Fig. 9 - the user interface can be provided with extra
 10 functions that can be activated by diagonal movements of
 the joystick. These movements lead in the first
 embodiment of the joystick to a simultaneous activation
 of two switches, e.g. a joystick movement diagonally
 upward and left will activate switches S1 and S4
 15 substantially simultaneously, i.e. an activation of the
 two switches within a short time window, e.g. 5
 milliseconds. In the second embodiment of the joystick
 the same movement will activate switch S4 only. The
 diagonal movements are according to a preferred
 20 embodiment associated with the following functions:

Mode				
Idle	Last dialed numbers	Phone number list	Volume	Change function center switch
Number	Backspace	Change to/from	Shortcut to idle	Change center

		navigation	mode	function
Text	Backspace	Change to/from navigation	Shortcut to idle mode	Change center function
Incoming call	Reject call			Change center function
Menu			Shortcut to idle mode	Change center function
Games	Navigate/steer/control	Navigate/steer/control	Navigate/steer/control	Navigate/steer/control

Table 4

The volume control can be in the form of an endless loop with increasing level that dropping back to low level at the end of the loop.

Fig. 10 is a flowchart that illustrates the operation of the process of entering a data value and controlling the mobile phone according to the second preferred embodiment. The process starts in step 10.1. The processor 18 monitors the state of the switches S1..S5 via interrupt request lines (IRQ). The interrupt request lines are defined in step 10.2. In step 10.3 the processor monitors if a combination of two sensors is activated simultaneously, thus detecting if any diagonal joystick movement has been made. If yes, the value of this sensor combination is saved in step 10.4 and in step 10.10 the data value allocated to the sensor activation combination is looked up in a table and in step 10.11 the allocated data value is entered. After entering the data

value the process returns to step 10.3 to monitor the activation of simultaneous activation of two sensors. If not two sensors are activated simultaneously, the process moves on to step 10.5 in which the processor 18 monitors
 5 if one of the sensors is active. If not, the processor returns to step 10.2. If one of the sensors is active, its value is saved in step 10.6. In step 10.7 the processor monitors if a second sensor is activated whilst the first sensor is still active. If yes, the value of
 10 the second sensor is saved in step 10. 8 and the process moves on to step 10.10. If no second sensor is activated whilst the first sensor is active the processor monitors in step 10.9 when the first sensor becomes inactive. The monitoring is continued until the first sensor has become
 15 inactive. Then, the process moves on to step 10.10. When the process arrives at step 10.10 the processor 18 looks up in a table which data value corresponds to the recorded sequence as shown in table 1 above.

20 Call handling

The mobile phone 1 has a plurality of states in which it operates. When the phone is switched on it will start in the idle mode, as shown in Fig. 1. In this mode the phone
 25 is ready to receive the entry of a phone number. The main area 23 of the display 3 shows an identification of the network operator concerned (here, a fictive company called MOBICELLTEL), as a so-called operator logo, and a dedicated area 21 shows the present functionality of the
 30 center sensor S5. The function of the center sensor S5 in the idle mode is access to the main menu loop of the phone.

With reference to Figs. 11.1 to 11.3 the placement of a call will be illustrated hereafter. In the idle mode digits are associated with the joystick movement sequences. When the joystick is moved from the centre position right (arrow 62) and then without returning to the center position is moved up (arrow 61) the processor recognizes that the activation sequence to which the digit "2" is associated has been carried out and the processor enters the digit "2" and shows it in the main area 23 of the display 3 (Fig. 11.1). The function of the center switch S5 changes to initiate call and the processor changes the soft label 22 to "Call". By performing further joystick movement sequences the complete telephone number is entered and the call is placed by activating the joystick in the center position. The phone status changes to the call establishment mode. The processor initiates the call and add the texts "Calling.." to the information displayed in the main area of the screen (Fig. 11.2). The processor also changes the functionality of the center switch S5 to terminate call and changes the soft label 22 to "End". When the call is established the phone status changes to the connected mode and the processor displays the text "Connected" in the main area of the display whilst maintaining the function of the center switch as call termination (Fig. 11.3). When the call is finished the user activates the centre switch "End" and the phone returns to the idle state (Fig. 1).

When a call is received the phone changes to the call receive mode and the processor displays a text identifying the caller when possible. The identification can either be the phone number or the calling the name associated therewith in accordance with the phone book

entries in the receiving phone (Fig. 11.4). The processor changes the function of the center switch S5 to answer call and changes the soft-label 22 to "Answer". The call can be rejected by moving the joystick diagonally left-up
5 "Clr". Alternatively, the call can be diverted to a voicemail service, if the phone or the network operator has such a function and depending on the settings when the joystick is moved diagonally left-up when during an incoming call. After rejecting/diverting the call the
10 phone returns to the idle state.

The mode of operation of the joystick can be switched from number entry to controlling cursor movement by moving the joystick diagonally right-up "Mode". A cursor
15 is then displayed, and the cursor can be moved back and forth, and if the entered number covers more than one line, also up and down by corresponding joystick movements. This is e.g. useful when a digit at the start of the number has been entered incorrectly. Both in the
20 number entry and in the cursor control mode the last entered digit / the digit just before the cursor is deleted by moving the joystick left-up "Clr". By moving the joystick diagonally right-up "Mode" the mode is returned to the number entry.

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Menu navigation

By activating the center switch S5 "Menu" in the idle mode (Fig. 1) the menu is entered and the display lists
30 the available menu items (Fig. 12.1) in a scrollable list with one item marked (marking in this embodiment by a reverse coloring of the text of the menu item concerned). The joystick is be used to jump from one menu item to the

next up or down in the list. The marked menu item is activated by pressing the center switch S5 "Select".

Stepping back in the menu is done by moving the joystick
5 diagonally left-up "Clr".

The phonebook is for example entered by activating the center switch S5 "Select" when the phonebook menu item is marked. Here, the user is presented the phone book
10 submenu items such as search numbers, list numbers, add number, edit number, delete number, etc (Fig 12.2). In the submenu items where an entry in the phone book is created or entered the names and eventually the address are edited by the multi tap like text entry mode
15 described in detail below. The numbers are entered as described previously.

Likewise any other menu items and submenu items can be accessed.

20

When activating a gaming application the joystick is often used exclusively or nearly exclusively for navigation, and the center switch for "firing" or the like. The default functions and shortcuts do thus not
25 work. Returning to the menu structure from such an application is done by activating the center switch for a long period, i.e. five second. The game or the like is of course automatically interrupted when an incoming call is detected.

30

In all modes other than the idle mode and gaming or the like mode, a joystick movement diagonally down-right is a shortcut directly back to the idle mode.

Shortcut Last dialed numbers

By moving the joystick diagonally left-up in the idle mode the last dialed members are presented in a scrollable list (Fig. 12.3). One of the numbers in the list is marked by reverse print and the user can jump from one menu to the other by using the joystick as a navigation instrument, i.e. pushing it up or down to move upwards and downwards respectively through the list. The function of the center switch S5 is "Call". A call is thus placed by marking the desired number in the list and then activating the center switch S5 "Call" (Fig 12.4). When the call is replied the text in the display changes to "Connected to ...". Call termination is as described previously. The dialed numbers list can also be accessed in the menu under the corresponding menu item

Shortcut to phone number list

Analogous to the last dialed number list there is a shortcut to the list of phone numbers in the phonebook by moving the joystick diagonally left-up in the idle mode. A call is placed by marking the desired number in the list by using the up-down function of the joystick and then activating the center switch S5 "Call".

Message handling

When an incoming message is detected the text "Message received" is displayed and the function of the center switch S5 changes to "Show". The message is shown if the center switch is activated. If instead the joystick is moved diagonally left up "Clr" phone returns to the idle state without showing the message.

Text entry/message creation with the predictive editor program

5 The predictive editor is a disambiguating software. An input from the joystick 2 is processed in an input manager. Input data is passed to a processing module, which keeps a record of the current input sequence until the user has accepted a word based on this sequence by
10 inserting a space. When a group of letters been received by the processing module, the current sequence of inputs (read: letter groups) is communicated to a prediction processor, which forwards the sequence to one or more modules acting as electronic vocabularies.

15

The vocabulary modules work in parallel and respond individually if they contain data matching the current sequence of letter groups. One vocabulary module may include a dictionary containing words in a natural
20 language, e.g. English, selected by the user and used as editing language. According to a preferred embodiment some of the other vocabulary modules may contain personalized user defined words.

25 The vocabulary modules often supply a plurality of matching words. The prediction processor accumulates a complete list of matching words for the selection list from all vocabulary modules. When the prediction processor has finalized the processing, the processing
30 module transfers the selection list to a display manager and the display 3 via the internal bus means.

In the most cases, the disambiguation software will work as an editor server and therefore pass data strings

directly to another client or application program running on the processor 18, too. In this case the joystick 2, the input processor and the display manager will be integrated in the application program using the predictive editor as a server. These applications may include the electronic phone book memory, notepad, messages, calendar, and internet browsing.

Vocabulary look-up processing.

10

Vocabulary look-up processing is handled by a computer program being available on the market. Therefore these parts will not be described further.

15 Writing a new message

A new message is created via the main menu item "Messages" and then selecting the submenu item "Create message". An empty message is then presented (Fig. 13.1)

20 The preferred embodiment of the text input according to the invention will be uses a predictive editor application. The core functionality of the predictive editor application is its ability to generate the intended text onto the screen from ambiguous inputs entered with the joystick movement sequences. This provides a more efficient method of entering text than the multi-tap method requiring many more joystick activations per letter due to the multiple activation of the centre sensor after a given joystick sequence.

30

The predictive editor program makes this possible because it is based on a large intelligent dictionary that allows the editor to predict what word the user intended based on the number of key-presses and combination of key-

presses. Often several words will match the keystrokes that are input and the user chooses the desired match from those offered by the predictive editor program.

5 With reference to Figs. 13.1 to 13.6 a display sequence illustrates the operation of the text input using the predictive editor program. In the initial display (Fig. 13.1), a cursor 70 indicates that the editor is ready for a "new" word to be typed to the editor. Above the text
10 area an icon 71 indicates the status of the phone (spelling) based on the predictive editor program. Furthermore the soft-label 22 indicates the functionality of the center switch S5 during the text entry "options". When activating the joystick diagonally left-up the phone
15 leaves the text editing mode and jumps one step back in the menu structure. When pressing the "Options" center switch S5 the user is offered a list of actions as "Send the text as an SMS", "Save the text", "Clear the display" and "Switch between predictive editor and multi tap
20 editor (the text editor that disambiguates by the number of activations of the center switch after each joystick movement sequence)". Further, the "Options" center switch S5 will provide the user with some editing tools that will be discussed later on.

25 When the phone has no other "softkey" than the center switch S5 the center switch will have the functionality "Options", while the "back" (i.e. step back in the menu structure) functionality is handled moving the joystick
30 diagonally up-left.

The layout of the letter groups and the associated joystick movement sequences are shown in Figs. 1 and 9. When starting to type a word (Fig. 13.1), the user simply

moves the joystick in the sequence belonging to the letter group containing the desired letter. Figs. 13.2 to 13.6 show displays how the user makes the following joystick movements in order to enter the word "case":

5

Right and then up to "2 abc" insert the "c"

Back to center

Right and then up "2 abc" to insert the "a"

Back to center

10

Down and then left "7 pqrs" to insert the "s"

Back to center

Right and back to center "3 def " to insert the "e"

Up and back to center "␣" to enter a space and finalize the word.

15

Often when entering the first few letters of a word, the predictive editor program is not yet able to display the intended characters and may erroneously display an unintended string of characters. These are therefore

20

displayed as merely temporary characters in the display while the predictive editor program is evolving a match. When continuing the typing of the remaining characters in the word, the displayed characters will become more accurate. No matter what the display shows, the user

25 simply enters the next character in the word he wants to type.

During the inputting of a word to the predictive editor program, all the characters in the word are shown with

30 underlining 74. This indicates that the word has not yet been finalized and all the characters shown underlined may still change as the predictive editor program evolves a match to the joystick sequences. As long as the

entering of a word is in progress the already entered part of the word remains underlined.

The user accepts a word by entering the character
5 "space", or by switching the predictive editor program
off. When the user accepts a word this will be frozen
meaning that the predictive editor program is no longer
working on it and the marking 74 will be replaced the
cursor bar 70. When spaces between words are deleted, the
10 two words are concatenated into one, but the user is
allowed to continue adding characters to the first word.
In any situation, the word will be finally inserted, the
text will no longer be underlined and the cursor 70 re-
appears after the accepted word.

15

The user can delete characters backwards in a word by
simply moving the joystick diagonally left-up "Clr" once
for each character to be deleted. The active word might
in this situation also change based on the remaining key
20 sequence. This is illustrated in Fig. 14.1 to 14.3 where
the suggested match "Car" in the display is changed to
"Cc" by deleting the last entered character and changed
again to "Can" by the joystick movement sequence down and
then left "6 - mno".

25

If the user deletes a complete word, the phone returns to
the "initial word entry" mode, and the user can again
type a new word.

30 If the user has typed a word and frozen the word by
moving the joystick up and back to the center "space",
and then clears this space after the word, then the
cursor 70 will be placed at the end of the word but the
predictive editor program will at this point no longer be

active (the already entered word will not be underlined).
 If the user clears from this state, he will remove the
 last character of existing word, and then this word which
 was left of the cursor 70 will become underlined and
 5 active again.

Special characters

While the predictive editor program is active, activating
 10 joystick sequence up then right " 1 " will allow a smart
 insertion of punctuation. This means that the predictive
 editor program will try to predict, based on the
 situation, which commonly used punctuation mark, is
 intended. These may include the period, comma, question
 15 mark, exclamation point, and apostrophe. If the user e.g.
 wants to type the word "can't", he activates the
 following sequence:

Right then up "2 abc " to insert the "c"
 20 Back to center
 Right then up "2 abc " to insert the "a"
 Back to center
 Down back to center "6 mno" to insert the "n"
 Up then right "1" to insert the apostrophe
 25 Back to center
 Left then down "8 tuv" to insert the "t"

The default value will most often suggest a period, if no
 other matches seem appropriate. The match function
 30 available on "*#" sequence up then left will also work in
 this situation, allowing the user to toggle through other
 choices like period, comma and similar special characters
 associated with the available on the "*#" sequence up
 then left.

Inserting digits in the text entry mode can be done in two ways. First of all, keeping the joystick in the last position of a sequence for a period longer than a given
5 threshold, i.e. two seconds directly inserts the corresponding digit into the editor. For example moving the joystick from the center position down and holding the joystick down for longer than two seconds will enter the digit "6". Moving the joystick left and then down,
10 and holding the joystick in this position for longer than two seconds will enter the digit "8". This is convenient when only inserting a few digits. However, for entering a long string of digits the menu "Options" has a submenu "Insert Number" that gives access to an insert number
15 query window allowing the user to insert a string of digits by joystick movement as described previously for entering phone numbers, i.e. without the need to hold the joystick long in the end position. This is done by performing the joystick movement sequence associated the
20 corresponding digit illustrated on the cover of the phone. After entering the desired number, the user presses the center switch S5 "OK" and the predictive text editing starts again.

25 The menu "Options" has another submenu "Insert Symbol" in which the user is given access to a plurality of symbols, characters and signs such as: @, \$, £ and letters not occurring in the language used in the dictionary. The symbols are displayed in a matrix, a symbol in the matrix
30 being marked by a cursor that can be moved/controlled by the joystick and the symbol marked by the cursor can be added to the text by activating the center switch S5 "Select".

Searching alternative matches

In some situations, the key sequence entered by the user might allow several words to "fit". In this situation, the predictive editor program will always first suggest the two most "common" words from the core dictionary. Here after all the whole word matches from the user dictionary will be shown, and finally all remaining matches from the core dictionary are shown. In some cases, the user might be looking for another word other than the immediately suggested one. There might be two or more possible matches to the key sequence. This is most often the case with short words.

The user can switch to other possible matches by moving the joystick up then left "*#". The predictive editor program will respond by presenting the next possible match.

However, the "Options" center switch S5 will include a submenu called "Matches" giving access to a list of matches the user can scroll through the list by pressing the center switch S5 that will have the functionality "Next match". The alternative match candidate will replace the active underlined word in the text and the alternative match candidate is selected in the same way as the default match candidate - e.g. by moving the joystick up and back to the center to enter a space. The list is handled as a loop. If no matches beyond what is already displayed then a note will be displayed saying "No Match Found".

If there are several matches to the key-sequence typed by the user, moving the joystick up then left "*#" will

immediately give the next possible match (the second most common match). A specific match from is finalized by finalizing the word as usual e.g. by inserting a space.

- 5 If the cursor 70 is touching a word that is not underlined and therefore not active, moving the joystick up then left "*" will also render the word active again and offer the next match.

10 No matching word

If the predictive editor program runs out of possible word matches during the typing of a word, the display will show a unique error symbol display directly after the entered characters and the center switch label 22 will change from "Options" to "Spell" providing a shortcut to the insert word query where the user can manually enter the desired word based on the multi tap editor type entry. The query should appear empty as seen 15 in the display of Fig. 13.1. The user is allowed to enter letters by performing the joystick sequence associated with the group of letters containing the to be entered letter, followed by one to three activations of the center switch S5 within a predetermined timeout period 20 (well known from conventional multi tap techniques on an alphanumerical keypad). One activation of the center switch S5 enters the first letter of a group, two activations of the center switch S5 enters the second letter of a group whilst three activations within the 25 timeout period enters the third letter of a group. This mode of entry is used for spelling particular words that can not be provided by the predictive editor program, and also to enter names in the telephone book. The user accepts the word by pressing the center switch S5 having 30

the functionality label 22 "OK" whereby the editor returns to editing by using the predictive editor program.

- 5 If the user continues to use the predictive editor program the last entered character will hence be displayed as an error symbol, to indicate to the user that no further possible words matches to the typed key sequence. The phone will emit a short alert beep to draw
10 attention to indicate the lack of matches. If the user types more keys in the situation the display will not show more characters and an information note saying "No Match Found" will be shown.
- 15 If the user finds out that he misspelled the word, he can simply move the joystick diagonally up-left "Clr", until the incorrect character can be changed. If the user chooses to accept a misspelled or unknown word e.g. by inserting space character, the error symbol will
20 disappear, and the last recognized word will be inserted into the text.

Cursor movement

- 25 Since the predictive editor program input method basically can only handle adding or deleting at the end of a word, the cursor handling is optimized for this.

Given the situation where the cursor is placed at the end
30 of the text. By moving the joystick diagonally up-right "Mode" the mode of the joystick changes to cursor control wherein up, down, right and left movements of the joystick cause corresponding movements of the cursor.

Using the joystick for scrolling left the editor will activate the entire word to the left of the cursor 70, allowing the user to add additional characters to the word (using both the pre-existing word and the new key-
5 presses to generate matches).

Scrolling left again by moving the joystick left will move the cursor 70 to the left of the word (the previously underlined word now no longer active for
10 editing and therefore no longer underlined) and the editor is ready to type a new word.

Scrolling left again moves the cursor to the end of previous word, underlining it, allowing the user to add
15 to that existing word. This cycle repeats when navigating through the text.

If the user moves the cursor 70 through several consecutive spaces, the cursor 70 will be moved one space
20 at a time. Also, when moving through symbols, numbers, etc., the cursor is moved one character at a time.

If the user wants to add a new word to the end or beginning of an existing word by using the predictive
25 editor program, this is simply done by first moving the cursor to the end or beginning of the existing word, respectively. From here, the user simply starts typing the new word.

30 The editor application opens the already written word for editing with the predictive editor program by placing the cursor in the desired position. Then the editor application regenerates the sequence of entries based on the presently displayed matching word. When the editor

application adds new entries to the regenerated sequence of entries in dependence of the position of the cursor and the key pressed. This new string is used by the predictive editor program to find new matches.

5

If the user wants to edit an existing word by using the predictive editor program, this is done first by moving the cursor just after the word (activating the word in question causing it to be underlined). Then the user can
10 directly add e.g. an ending to the word or if desired, can delete characters by moving the joystick diagonally left-up "Clr".

Whenever the "Insert word" query is selected, by
15 activating the center switch S5 "OK", the words that were entered in the query are added both to the user dictionary as well as to the main editor window. A confirmation note "Word saved" appears as well. Upon re-entry to the predictive editor program, insertion point
20 will be after the last letter of the manually only spelled word.

Moving the joystick diagonally up-right "Mode" for a second time brings the mode of the joystick back to text
25 entry.

Options lists

The "Option" menu in the predictive editor program will include some submenu items as:

30

Matches

Next Match

Insert Word

Insert Number

Insert Symbol

Dictionary

The match related items and the insert related items have
5 already been discussed above. All languages supported by
the predictive editor program for the phone will appear
as choice items under "Dictionary" submenu item. The
default language follows advantageously the display text
language of the phone. This default may be to turn the
10 predictive editor program off and revert to multi tap
type input for the display text language when the
predictive editor program does not include a dictionary
supporting the language in question. Changing to another
language will simply cause the predictive editor program
15 to run in the new language.

User dictionary

The predictive editor program may supports a user
20 dictionary, where words not initially known by the
program can be stored.

Editing concept

25 The basic editing concept is shown in Fig. 15. When the
predictive editor is started up the editor starts to wait
for a joystick activation sequence in step 100. When a
joystick activation sequence is detected the data value
allocated thereto is added to a joystick input string and
30 transferred to the predictive editor program in step 101.
The predictive editor program responds to this input in
step 102 and in step 103 the processor 18 investigates
whether the predictive editor program could find possible
matches.

If no possible match is found in step 103 the last possible match is displayed in step 104 together with an error symbol and the function of the center switch S5 is
5 changed to a short cut to the multi-tap spell mode.

If the user in step 105 accepts (by entering a space) the last possible match this word will be added to the text. Hereafter the joystick activation sequence string is
10 cleared in step 106 and the editor starts to wait for a joystick activation sequence in step 100.

If the user in step 106 goes to the multi-tap spell mode he can enter the intended word in an unambiguous way in
15 step 107. When accepting the entered word by pressing center switch S5 this word will be added to the text. Hereafter, the input string is cleared in step 106 and the editor starts to wait for a joystick activation sequence in step 100.

20

If the predictive editor program was able to find matches in step 103 the preferred one is displayed in step 108. In step 109 the next joystick activation sequence is read. In step 110 it is checked whether the user searches
25 for alternative matches by moving the joystick left then up "+*". If this is the case the alternative match is displayed in step 111.

In step 112 it is checked whether the user accepts the
30 displayed word by activating the center switch. If this is the case the word will no longer be active and will be added to the entered string of words in step 113. Hereafter, the input string is cleared in step 106 and

the editor starts to wait for a joystick activation sequence in step 100.

If the joystick activation sequence is deemed to
 5 represent an ambiguous character the editor goes to step 101 for adding the joystick activation sequence to the input string for looking up matches.

Fig. 16 illustrates a third preferred embodiment of the
 10 invention in which the joystick is replaced by four keys K1,K2,K3,K5. Switches S1,S2,S3 and S4 (not shown) are associated with keys K1,K2,K3 and K5 respectively. The operation of the keys is analogous to the first and second preferred embodiments described previously. Data
 15 values are allocated to activation sequences in accordance with the table 5 below:

First state active switches:	Second state active switches:	Data value entered
S1	-	0
S1	S1+S2	1
S2	S1+S2	2
S2	-	3
S2	S2+S3	4
S3	S2+S3	5
S3	-	6
S3	S3+S4	7
S4	S3+S4	8
S4	-	9
S4	S1+S4	10
S1	S1+S4	11

Table 5

In a number input state the entered data is equal to the data value concerned. In a text input mode letter groups having a plurality of letters are associated with the data values. Disambiguation is performed by multi tapping or using a predictive editor application as described above with reference to the first and second embodiment.

Fig. 17 discloses a variation of the third preferred embodiment, in which a fifth "enter" key with an associate switch S5 is added.

Data values are allocated to activation sequences in accordance with the table 6 below:

First state active switch:	Second state active switch:	Third state active switch:	Data value entered:
S1	-	S5	0
S1	S2	S5	1
S2	S1	S5	2
S2	-	S5	3
S2	S3	S5	4
S3	S2	S5	5
S3	-	S5	6
S3	S4	S5	7
S4	S3	S5	8
S4	-	S5	9
S4	S1	S5	10
S1	S4	S5	11

Table 6

The further processing of rendering a data value into a letter or number entry is as described above.

The invention has been described in detail with reference
5 to a mobile phone. It is however understood that any
other eclectic terminal could profit from the present
type of input method and device. Also, other types of 4-
way input devices such as e.g. trackballs can be used for
the present invention. The input device has been
10 illustrated without any other keys in the user interface.
It is though also possible to combine the input device
with more hard and/or soft keys.

Although the present invention has been described in
15 detail for purpose of illustration, it is understood that
such detail is solely for that purpose, and variations
can be made therein by those skilled in the art without
departing from the scope of the invention. Thus, while
the preferred embodiments of the devices and methods have
20 been described in reference to the environment in which
they were developed, they are merely illustrative of the
principles of the inventions. Other embodiments and
configurations may be devised without departing from the
scope of the appended claims.

25